

Protected areas, conservation and resource capacity: Historical lessons for conservation from Western Australia's South Dandalup Reserve

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ABSTRACT

Impacts on the forested bioregions of south-western Australia have, since first European settlement in 1826, been extensive and dramatic. Large-scale land clearing removed over two-thirds of the vegetation for agriculture and urbanisation. Other significant threats to the biota include: changed fire regimes; exotic predators, diseases and herbivores; and drought and climate change. Conservation reserves in the region were originally chosen on aesthetic appeal, often aligning poorly to modern CAR (comprehensive, adequate and representative) criteria aspiring to conservation of at least 10% of each bioregion.

The entire period of European occupation of the region has been characterised by the need to balance different land uses within a changing political context, broadening in recent years to incorporate indigenous culture and heritage. Thus much may be gained by a historical perspective grounding contemporary policy in an understanding of the successes and failures of the past. Here, we consider the historical development of the unique perspectives from forestry, agriculture and conservation through the late 19th and early 20th centuries, before assessing their interplay with newer concerns. This experience illustrates that society can design management systems to conserve biodiversity and ensure long-term sustainable use of renewable resources, but that the political will is often lacking.

Key words: South Dandalup, CAR criteria, Lane Poole, jarrah forest, conservation reserve

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Introduction

The south-western corner of the Australian continent includes the c. 360,000 km² South-west Botanical Province, an internationally recognised biodiversity hotspot extending between latitudes 26° and 36°S and longitudes 114° and 126° east (Beard *et al.* 2000; Myers *et al.* 2000; Burrows 2008). The forests of this area occur principally in three biogeographic regions: Swan Coastal Plain, Jarrah Forest, and Warren (Wardell-Johnson *et al.* 1997) (Figure 1). These regions encompass that part of the south-west receiving more than 600 mm mean annual rainfall – an area of about 4.25 million hectares. Approximately 2.5 million hectares of publicly managed land occurs within this region (Conservation Commission, WA 2004). Mild winters, a pronounced winter rainfall maximum, and the regular summer/autumn drought, characterise the Mediterranean-type climate (McCaw and Hanstrum 2003). Jarrah *Eucalyptus marginata* occurs throughout the region and is dominant in the Jarrah Forest Bioregion, a heavily lateritized landscape, where it can occur as the dominant tree over large areas. It is historically the most commercially important of Western Australia's hardwood trees. Karri *E. diversicolor* is also

commercially important, occurring mainly in the Warren Bioregion, while other species such as marri *Corymbia calophylla*, and blackbutt *E. patens* often co-occur with jarrah or karri (see Wardell-Johnson *et al.* 1997). Inland, these forests grade into woodland and mallee dominated bioregions extensively deforested for agriculture. In each bioregion, forests occur in a matrix of vegetation types reflecting an extraordinarily long, complex geological and climatic history, featuring high alpha and beta plant diversity (Wardell-Johnson and Horwitz 1996).

There are detailed accounts of the distribution, history, silviculture, and ecology of the jarrah forests (Dell *et al.* 1989, Bradshaw *et al.* 1991, Wardell-Johnson *et al.* 1997 and included references, Stoneman *et al.* 2005). With regard to the fauna, recent studies show that in the broader south-west region *in situ* speciation has contributed to endemic lineages in a range of invertebrates, including snails and sedentary arthropods, and in freshwater fish and herpetofauna. Much lower endemism occurs in birds and mammals (Rix *et al.* 2014). Within the jarrah forest specifically, species

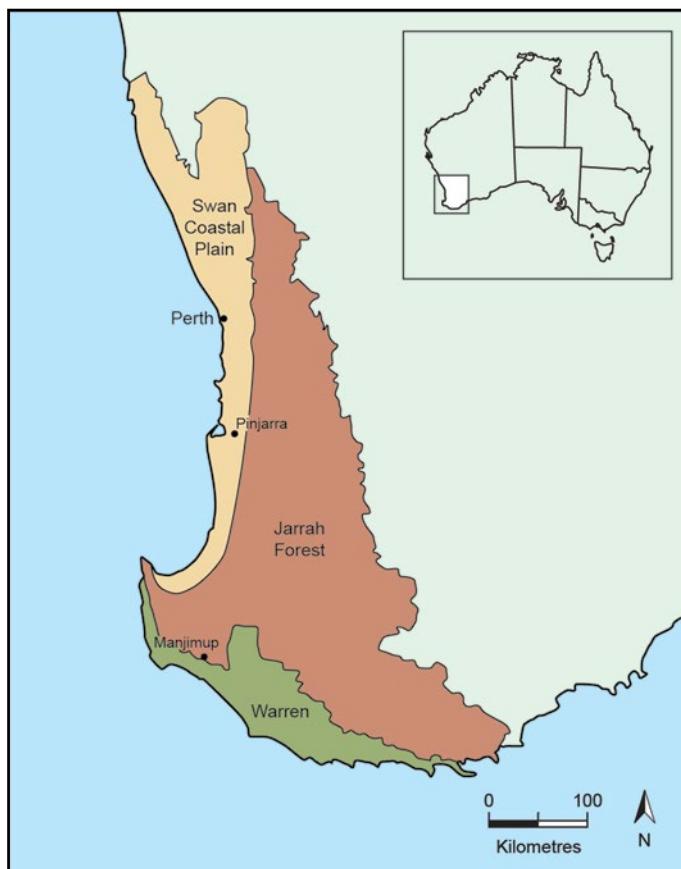


Figure 1. The forested bioregions of south-western Australia (after Thackway and Cresswell 1994). Place names mentioned in the text are included.

richness of vertebrates, including birds and mammals, is lower than that found in eastern Australian eucalypt forests (Nichols and Muir 1989). This is also true of freshwater fish and freshwater insects (Bunn and Davies 1990). Nevertheless, the forested regions of the south-west have concentrations of endangered freshwater fish (Morgan *et al.* 2011), birds (Garnett and Crowley 2000, p. 624) and mammals (Figures 1 and 2 of Maxwell *et al.* 1996). The conservation status of some of these species continues to decline (e.g., Western Ringtail Possum *Pseudocheirus occidentalis*, Woinarski *et al.* 2014).

Impacts on the South-west Botanical Province have, since first European settlement in 1826, been extensive and dramatic. Large-scale land clearing, mapped in detail by Jarvis (1981), removed over two-thirds of the vegetation for agriculture and urbanisation and at the turn of the current century less than 11% of the original area was reserved (Beard *et al.* 2000; Myers *et al.* 2000). Other threats to the biota include: changed fire regimes (Abbott and Burrows 2003; Burrows 2008), predation by introduced foxes *Vulpes vulpes* and cats *Felis catus* (Kinnear *et al.* 2002), habitat destruction or competition from introduced herbivores (rabbits and feral stock) and from domestic stock grazing (pastoralism) (Woinarski *et al.* 2014), direct threat and habitat change arising from exotic diseases (Garkaklis *et al.* 2004; Shearer *et al.* 2004,

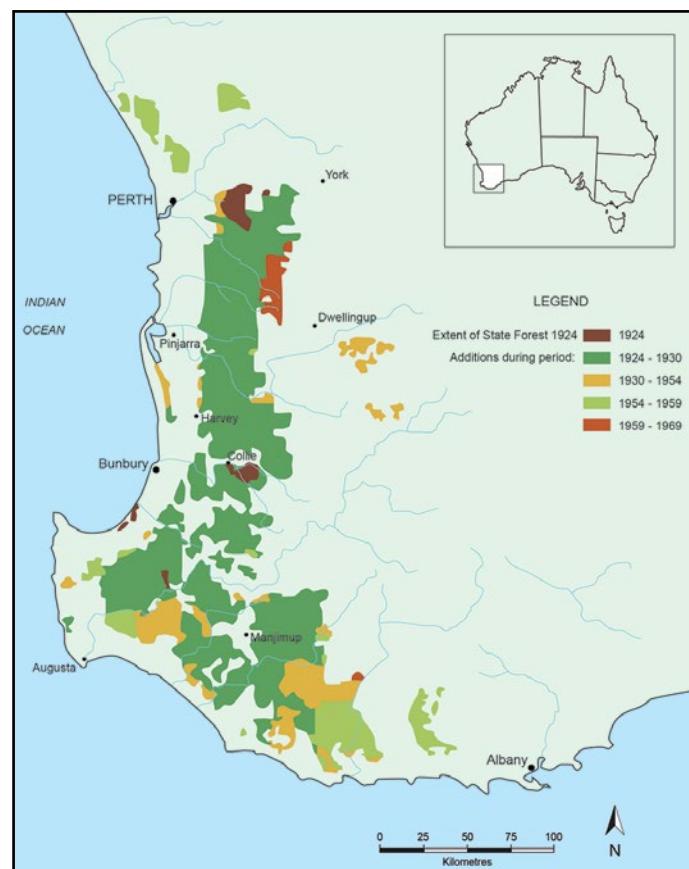


Figure 2. The State Forests of Western Australia and the timing of their dedication. (After Jarvis 1981 and Williamson *et al.* 2005).

2007; Bishop *et al.* 2011), drought and climate change (Wardell-Johnson *et al.* 2004; Wardell-Johnson *et al.* 2011), flood mitigation and dam building (Garnett *et al.* 2011), drainage of swamps and wetlands (Maxwell *et al.* 1996), salinisation (Garnett *et al.* 2011), decline of food sources (Blakers *et al.* 1984), human exploitation or persecution (including collecting for aviculture, game hunting, sport shooting, fur trapping, and deliberate culling by shooting, shelter destruction or poisoning to protect crops or livestock) (Thomson *et al.* 1987), epizootic disease (Abbott 2006; Thompson *et al.* 2014), road traffic (Saunders 1982), inbreeding (Garnett *et al.* 2011), and forestry practices (Calver and Dell 1998a,b; Woinarski *et al.* 2014). Their combined impacts are substantial. Considering only mammals at the end of the 20th century as an example, in the densely populated Swan Coastal Plain Bioregion, 10 mammal species were locally extinct and a further seven were classified as threatened in Commonwealth or State legislation (Armstrong and Abbott 1995). In the northern and southern jarrah forests four mammal species were locally extinct and a further 12 were classified as threatened in Commonwealth or State legislation (Calver and Dell 1998a).

Conservation reserves in the region were originally chosen on aesthetic appeal before a shift to a consideration of botanical regions in the 1950s and, most recently, adoption

of CAR (comprehensive, adequate and representative) criteria aspiring to conservation of at least 10% of each bioregion (Rundle 1996; Gove *et al.* 2008). In common across these different approaches is the need to balance different land uses within a changing political context. Thus the social and political debates over land use from a century ago have a contemporary ring and much may be gained by an historical perspective that grounds contemporary policy in an understanding of the successes and failures of the past (Lunney and Moon 2012). The greatest social influences shaping land use in south-western Australia during the late nineteenth and first half of the twentieth centuries were forestry, agriculture, and conservation (Moore 1993). Here, we consider the historical development of the unique perspectives from forestry, agriculture and conservation through the late 19th and early 20th centuries, before assessing their interplay with newer concerns such as tourism, mining, and indigenous heritage. By taking a historical perspective, we hope to come closer to understanding the complex of values and perspectives that interact to produce the reserve policies of today.

Lane Poole and the Forestry Professionals

In the paper which follows the reader may feel that the author is unduly congratulatory to the Forest Service of Western Australia on the subject of the high standard which has been reached in a short period of time over a large area of 5 million acres of Eucalypt forest. ... this development has been greatly assisted by nature and the general economy of the State and taken advantage of by those Forestry leaders who have guided the planning. (Nunn 1957, pp. 3–4)

George Nunn's extraordinary *apologia* at the beginning of his report to the Seventh British Commonwealth Forestry Conference in 1957, regarding forest management in Western Australia, leaves no doubt that the Forests Department of the time had pride in its achievements and confidence in its ability to manage the forests. This was a legacy of three outstanding foresters: David Hutchins, Charles Lane Poole, and Stephen Kessell.

Hutchins had retired from a distinguished career as a forester when, after Royal Commissions in 1877 and 1903 had not solved problems in the Western Australian timber industry, he was invited to advise the Western Australian government. His voluminous report advocated forest reservation, a professional forestry cadre and public education (Hutchins 1916). Following the death in 1899 of Western Australia's first Conservator of Forests, Ednie-Brown, Hutchins recommended Charles Lane Poole for the position (Dargavel 2008).

Lane Poole arrived to great promise and great challenge. The promise came from the size of Western Australia's hardwood trade, then the world's largest. There was also

support for sustainable forestry from politicians Philip Collier, Robert Robinson and Walter Kingsmill, as well as the Australian Forest League, a society of timber industry figures and other citizens. The challenge came from entrenched industry interests, especially Millars' Timber and Trading Company, Ltd., which held large, long term concessions and leases (Dargavel 2008). Lane Poole soon realised the political realities, which were not helped by his fiery personality. Mills (2002) assessed him as 'a very arrogant man', although some contemporaries remembered him as a man of charm and courtesy (Wood 2005).

Lane Poole's principal achievement was the Forests Act, passed on December 20th 1918, after exhaustive debate. It demarcated State Forest reserved for timber production in perpetuity, managed to sustained yield principles by professional foresters following detailed working plans for different forest blocks (Williamson *et al.* 2005; Dargavel 2008). Contemporary and later commentators praised it as a model Act (Rodger 1952; Dargavel 2008).

Lane Poole initiated, continued or supported other significant policies. He resisted agricultural alienation of forested lands and established arboreta to continue trials of exotic species for softwood production. Professionalism in forest management was enhanced by establishing the Ludlow school for forestry apprentices in 1921 and support for degree qualifications for foresters nationally, culminating with the opening of the Australian Forestry School in Canberra in 1926. He initiated publication of departmental bulletins documenting scientific assessment of forest issues and provided textbooks (Williamson *et al.* 2005). Lane Poole also supported public education on forestry principles, especially the concepts of 'forest capital' (the total marketable timber) and 'forest interest' (the growth increment on that capital) (Lane Poole 1921). They justified increasing the area of State Forest (forest capital), containing logging to within the forest's growth increment (forest interest), reforestation on areas despoiled by overcutting, removing overmature, senescent or non-commercial trees, protecting regrowth from fire and converting State Forest to even-aged stands suitable for logging rotations (Lane Poole 1920a).

Despite these successes, Lane Poole failed to maintain political allies, to negotiate successfully with sawmillers, especially the Millars group, or to win press support. He resigned in frustration in 1921. His brief period as conservator was 'a considerable achievement' (Dargavel 2008).

Stephen Kessell, a returned serviceman with a forestry diploma from Oxford University, followed Lane Poole. He is described as being of 'amazing confidence and charm' (Mills 2002) and 'the most politically astute forester of his generation' (Dargavel 2008). His tenure began well, because in 1922 the State's third Royal

Commission into forest management confirmed the desirability of strict forest management (Dargavel 2008), as outlined in the Forests Department's annual report (Kessell 1922). The area of dedicated State Forest grew rapidly and by 1930 approximated 60% of its current extent (Figure 2) (Williamson *et al.* 2005). Achieving a sustained timber yield on State Forest lands proved daunting. Given the unacceptability of closing many mills, the 1928 Working Plan for jarrah sought a sustained yield in a decade based on a gradual decline in logging volumes (Kessell 1928). The steep fall in domestic and export demand following the Great Depression of 1929 helped achieve this, with logging reduced steadily to within the growth increment by the early 1940s (Kessell 1932, 1935, 1938; Stoate 1947; Calver and Wardell-Johnson 2004).

The achievement did not last because post-war demands for timber and jobs strained forest management. In 1953, Conservator Stoate spoke out: 'This year's production represents a far greater output than the forests of the State can maintain, and moreover, the rate of cut is still increasing' (Stoate 1953, p.1). His contract was not renewed (Mills 1986).

Douglas 'Dick' Perry, whose career began in 1917, expressed the position clearly:

We made determined efforts ... to get the karri and jarrah on a sustained yield basis and as far as I am aware, I don't think we ever succeeded. It was political. They wouldn't shut down sawmills and little towns which became very necessary if you were going to work on a sustained yield basis. It certainly wasn't the foresters (sic) fault. It was the politicians (sic) fault. They wouldn't make the tough decisions. ... We tried our best to tell governments what to do, and how to do it, but that's all we could do, by law. (Borschmann 1999, p. 188)

Nunn's apologia is understandable in this light. Western Australian foresters were united by common education and goals, a sense of mission, a toughness and resilience that came from the long negotiations with politicians and industry, and the proud achievement of dedicating substantial areas of State Forest brought, albeit briefly, to sustainable management. They were, however, handicapped by a European-derived understanding of the forest ecosystem. Nonetheless, at the very least, forest conservation benefitted from dedication as State Forest, which '... was a hard slog by an insular Forests Department against many opponents' (Rundle 1996, p. 225). It has left open the option of managing native forest today from a deep-time perspective (e.g., Mucina and Wardell-Johnson 2011, Hopper 2013). This experience illustrates that society can design management systems to ensure long-term sustained yield, but that political will is often lacking.

'Moo cow' Mitchell and the Agricultural Dream

For the farmer, I have promised reduced taxation, and for the suitable applicant land. ... The world's food requirements are at once our opportunity and our danger – opportunity to people the country and reap a rich crop of annual wealth, danger because a hungry world is looking for idle lands on which to grow more food. ... Herein lies our great strength. To get the last acre selected and the whole of the cultivable land put to its fullest use is the aim of my party. (James Mitchell in 1930, quoted in Bolton 1992, pp. 69–70).

In 1917, a Royal Commission into the prospects for a railway opening up substantial agricultural clearing in the mallee belt north of Esperance rejected scientific advice that the project would encourage dryland salinity. The Commissioners argued that '... scientific prejudice against our mallee lands be not permitted to stand in the way of their being opened up' (quoted in Bolton 2008, p.105). Even for the times it was an extraordinary attitude of development at all costs, and frequently brought forestry and agriculture into conflict over the best uses for forested or wooded land.

One of the strongest advocates for agricultural development was James Mitchell, who was member for Northam between 1905 and 1933 and twice Premier (Bolton 2011). In parliament, he clashed with Robert Robinson, who supported Lane Poole, over Mitchell's '... predilection for the destruction of trees and the growth in their place of grass or turnips' (Bolton 2008, p.110). Eventually Mitchell accepted that timber production was the right use of the best forested lands, but dedication of State Forest still proceeded more slowly during his years as Premier than at other times (Bolton 2008).

Mitchell is often remembered for his drive to settle the south-west with dairy farmers in the Group Settlement Scheme. He saw it as a logical development for a region with reliable rainfall and where timber was the only major industry, arguing that it could make the state self-sufficient in dairy products and vegetables. In 1921, pilot projects began near Manjimup. However, neither the supervisors nor many migrants had the experience or skills for clearing hardwood forests. Much timber was burned because logs could not be taken to the mills and cleared land was often infertile. Even where pasture was established, settlers had difficulty getting by on the dairy cattle available. Opportunities to diversify were limited by low local demand and transport difficulties to Perth. By 1924, nearly half the migrants had abandoned the group settlements (Bolton 1992).

Later commentators were ambivalent about Group Settlement. One obituary referred favourably to Mitchell's record in opening the eastern agricultural districts, but ignored his south-west initiatives (Anonymous 1951).

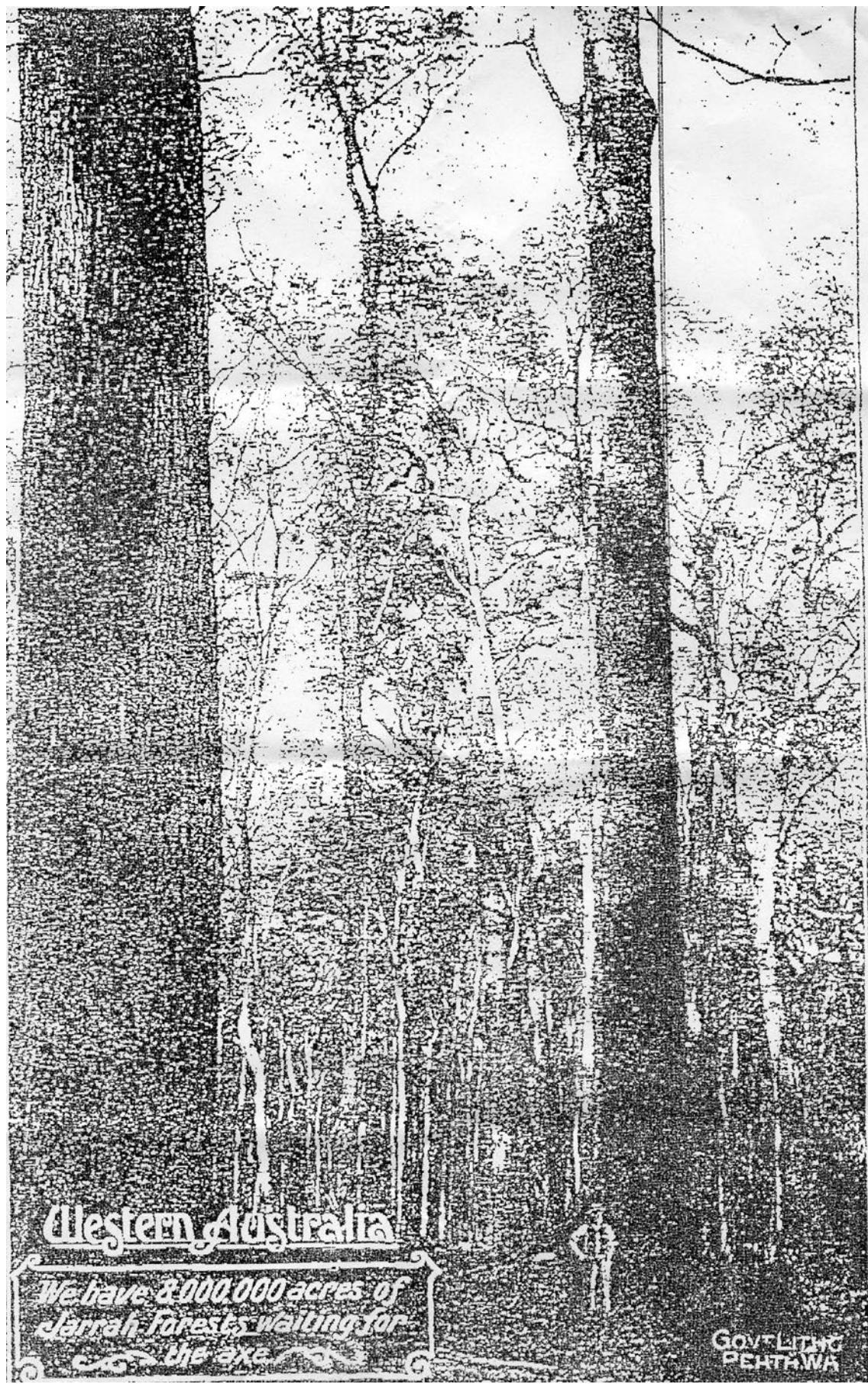


Figure 3. Recruitment poster for settlers in the jarrah forest. Unfortunately, this is the best quality available. The slogan reads: 'We have 8,000,000 acres of Jarrah Forests waiting for the axe.'

However, he is credited with establishing a dairy industry in the south-west, along with several townships and better transport links (Bolton 1992, 2008).

Agriculturalists and the foresters shared a desire to win wealth from the land – agriculturalists through sustainable food production and foresters through a sustainable timber industry (Moore 1993). Mitchell referred to producing wealth from the soil (Bolton 1992) and surveyor-general Roe called the prime jarrah forests the ‘... most readily available sources of wealth in this colony’ (Roe 1852, pp.56–57). The similarity ends there. The agricultural pioneers sought land ownership and long-term stewardship of private property, whereas the foresters sought to manage public lands for the public good. There was no professional bond among agriculturalists, although some commentators saw a social bond akin to communism among the group settlement labourers (Bolton 1992). The foresters had, of course, their common professional training. The conflict between them is shown sharply in an early 20th century government lithograph. One man stands in a grove of great jarrah above the caption: ‘We have 8,000,000 acres of Jarrah Forests waiting for the axe’ (Figure 3).

Lost Opportunity: the Case of Reserve Number 2461

There is some very fine timber upon this reserve but it is simply going to waste and should certainly be utilised. (Ednie-Brown, Conservator of Forests, 1897, quoted in Rundle 1996, p. 229).

Throughout the 19th century the concept developed that land should be set aside for public recreation, the conservation of wildlife or the protection of sites of great natural beauty. One major sign was the establishment of Yellowstone National Park in the USA in 1972, Royal National Park in Australia in 1979 (Lunney 2014), and another major sign was the growing interest by scientists and amateur natural historians in indigenous flora and fauna. Two of these groups, the Australasian Association for the Advancement of Science (founded in 1888), and the Western Australian Natural History Society (founded 1897, and later to become the Royal Society of Western Australia), combined in the late 19th and early 20th centuries to push for a major nature conservation reserve in south-western Australia, in direct competition with agricultural and timber interests.

The Western Australian Natural History Society boasted powerful friends. In the 1890s, Premier Sir John Forrest was the president, the governor, Sir William Robinson, was patron and Bernard Woodward, curator of the Western Australian museum, was secretary. At a society meeting in 1892, Robinson argued for flora and fauna reserves in Western Australia to conserve habitat, as distinct from beautiful scenery. Forrest supported him (Moore 1993). Minds were therefore prepared when the

Australasian Association wrote to Forrest, inquiring about the availability of nature reserves in Western Australia. Forrest referred the letter to Woodward (Rundle 1996).

Woodward recommended 64,000 hectares along the South Dandalup River south-east of Pinjarra. He considered it unsuitable for agriculture because of the difficult terrain and the abundance of toxic plants (native species from the genus *Gastrolobium*), and too remote to interest the timber industry (Mills 1989). Forrest agreed, and reserve 2461, the South Dandalup Nature Reserve, was approved in February 1894. Unfortunately, this was one year before the passing of the *Parks and Reserves Act* 1895, under which the government created boards of management for reserves with power to manage and protect them. Thus the South Dandalup Reserve lacked that level of governance and protection. Although representatives of the Australasian Association urged Woodward to make the reserve a national park, he and his colleagues thought the task was done (Rundle 1996).

Woodward’s optimism was misplaced. In 1897 Conservator of Forests Ednie-Brown supported requests to cut timber for telegraph poles and jetty piles in the reserve, claiming that good timber was ‘going to waste’ (Rundle 1996, p. 229). Mills (1989, p. 264) saw it as an example of ‘... the timber industry, in deadly competition with itself’ and noted that within four years sleeper cutters were issued permits to cut timber in the reserve. Agricultural interests requested release of lands for orchards along the fertile river valley (Rundle 1996). Commissioner for Crown Lands, George Throssell, sought to balance competing interests by reducing the reserve to 20,000 hectares, which should be ‘... the best land suited for the purpose, containing a diversity of timber and some of the very finest’. Throssell then envisaged introducing exotic animals such as deer into the reserve (Moore 1993).

Throssell’s recommendation foreshadows the modern CAR principle – Comprehensive, Adequate and Representative – for reserve design (Fitzsimmons and Robertson 2005; Sharafi *et al.* 2012). A comprehensive reserve system encompasses all aspects of biodiversity from genes through species to communities and ecosystems. To be adequate, a reserve should be sufficiently large to maintain viable populations and reduce susceptibility to the surrounding human-disturbed environment. To be representative, species, communities and ecosystems should be included from across their geographic ranges. While Throssell’s suggestion to introduce exotic animals seems less far-sighted, some modern conservationists advocate relocating endangered species into favourable habitat, even if it is beyond their former range (e.g. Bowman 2012).

Throssell’s suggestion went to the Executive Council, but it was never implemented. However, the reserve was maintained and the plan to reduce its size shelved. Woodward sought unsuccessfully in 1902 to vest the

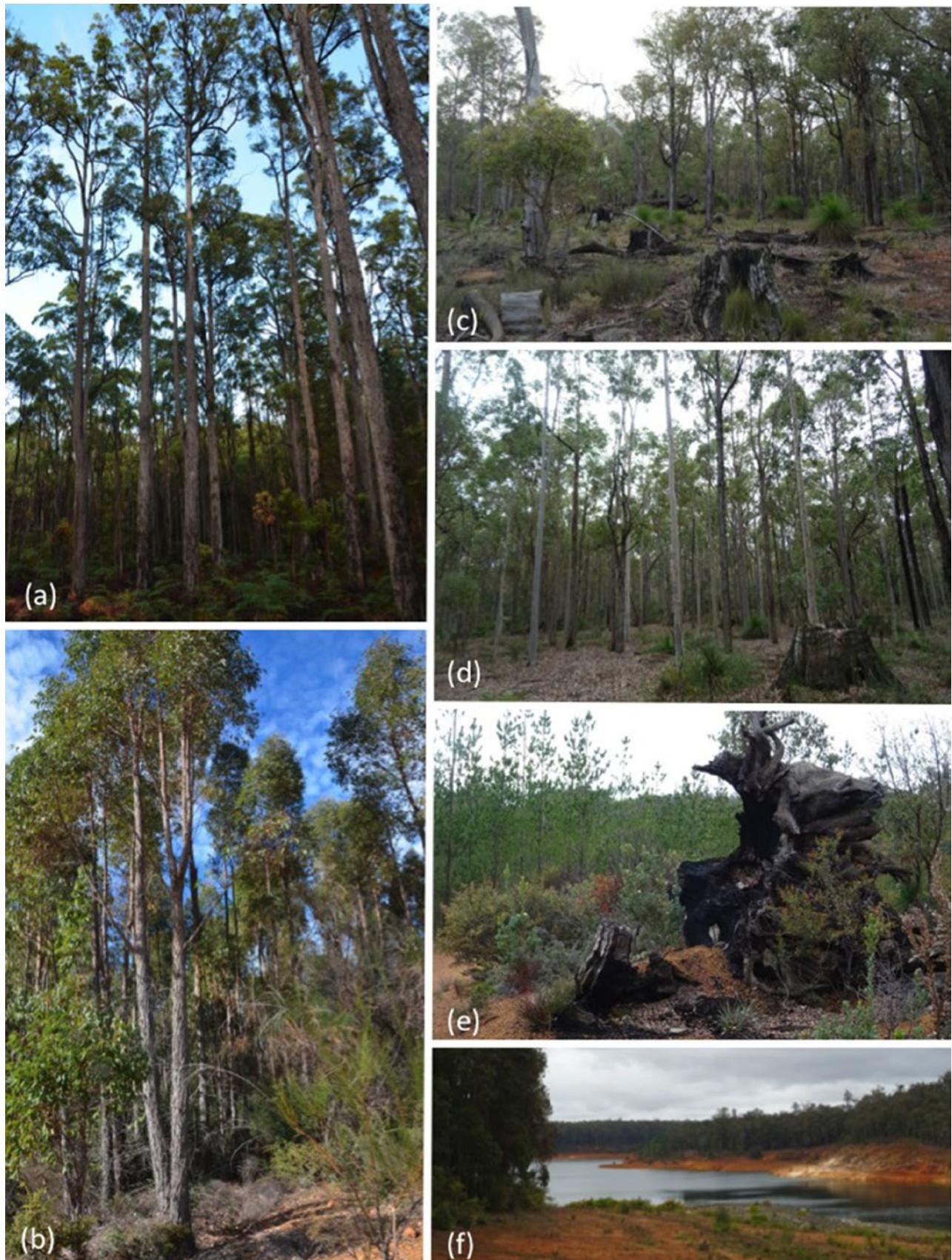


Figure 4. Contemporary landscapes in the high rainfall zone (> 1100 mm MAR) of the Jarrah forest in the South Dandalup catchment: a) High quality jarrah regrowth following stand tending; b) Bauxite mine rehabilitation (mid 1990s); c) Regrowth and remnant stand along Scarp Road; d) Rehabilitation under the 1980s Forest Improvement and Rehabilitation scheme. The eucalypts pictured include *Eucalyptus marginata* (remnants), *E. resinifera*, *E. saligna*, *Corymbia calophylla* (remnants) and *C. maculata*; e) Pine (*P. radiata*) plot and remnant coarse woody debris along Scarp Road; and f) South Dandalup Dam (28th August 2015). All photographs by Grant Wardell-Johnson.

reserve in trustees. Instead, conditional permits were granted to cut timber, despite recommendations to stop logging in the reserve by the Royal Commission into forestry in 1903 (Moore 1993). In 1907, Premier Moore rejected a petition to make the South Dandalup Reserve a national park and establish a board of trustees for its management. He took advice from senior public servants that the valuable timber on the reserve outweighed any need for conservation, dismissed the credibility of the petitioners to assess the timber value of the reserve, and accepted the argument that water catchment reserves could double as conservation areas (Moore 1993). In 1911, the South Dandalup Nature Reserve was changed to 'Timber – Government Requirements' and ultimately designated as State Forest (Rundle 1996). Today, as well as cleared agricultural land, the South Dandalup catchment includes jarrah regrowth following logging; rehabilitated bauxite mines; rehabilitated native forest and pine plantations. The South Dandalup River has been dammed (Figure 4).

The unifying strand in the arguments for the South Dandalup Reserve was that the conservation of flora and fauna is more than an economic decision. Utilitarian views, such as tourism and recreation opportunities, might have developed if the reserve had a longer life, but they were not at the forefront of the initial campaign.

Modern conservationists justify conservation under utilitarian, aesthetic, ecological, and ethical arguments (Beattie 1995, Horwitz and Wardell-Johnson 2009). Utilitarian arguments focus on the potential uses of compounds extracted from flora and fauna for pharmaceuticals or industrial chemicals, or on sustainable tourism in which people pay for viewing wildlife or scenery in non-destructive ways. Aesthetic arguments focus on the value of wildlife and natural areas for the enrichment they provide to human lives – with the possible utilitarian payoff that exposure to nature may be a therapy for some psychological problems. The ecological perspective highlights the fundamental ecological principles that all living things are interconnected in ecosystems characterised by recycling of nutrients and flows of energy. Thus protected areas maintain supplies of clean water, pollinators for agriculture, insectivores to control pest populations, and so on. Ethical arguments attribute intrinsic value to all life forms irrespective of their value to humans, or argue intergenerational equity where one generation should not take decisions that close certain options for future generations.

Conservation is also notable for the diversity of amateur and professional interests involved in putting the case – in the example of the South Dandalup Reserve, scientists, public servants, politicians and a wide range of lay people participated. Today, a diversity of societies with conservation as a focus such as the long-standing

Western Australian Naturalists' Club (founded in 1924) continue the tradition of diversity in members interested in the environment. There are also attempts by professional scientists to convey conservation messages to the wider public, as well as to politicians and public servants (Wills and Hobbs 1998). Diverse sections of the public also remain strongly involved in conservation issues (Gaynor 2014).

Lessons from the past

Any meaningful dialogue between competing interests is helped if all parties communicate their values, objectives and motives. This agrees well with the view that negotiations should begin with identification of agreements – often identifying substantial common ground – before resolving disagreements (Kirkpatrick 1998). For forestry, agriculture and conservation, such common ground can be found in stewardship, professionalism, and utility.

All share a long-term concern for stewardship of land. Lane Poole expressed it for the foresters of the early twentieth century: 'With proper forest management and sound sylvicultural [sic] treatment there is no reason why there should not be built up on the wreckage of the once splendid forests of Western Australia tended forests which will yield for all time 100 cubic feet of timber per acre per year' (Lane Poole 1920a, p. 31). The agricultural view was of long-term prosperity based on sustainable farming, while the conservationists wanted to preserve unique flora and fauna for further scientific study and the enjoyment of future generations.

By the early twentieth century there were clear areas of overlap between these concerns. For example, Lane Poole's textbook, *A primer of forestry: with illustrations of the principal forest trees of Western Australia* (Lane Poole 1921) describes non-tree vegetation and the fauna. Although the perspective is utilitarian (animals are described as pests or helpful, for example), it does not ignore them. Similarly, he acknowledged aesthetics:

When what remains of the present over-mature crop of jarrah and karri has been cut down, it is unlikely that specimens equal in bulk to what the forests have already yielded or still possess will be seen by future generations. ... Sentiment may dictate the preservation of a few ... as reminders of the giants of former days, but whole forests of giant trees will no longer be seen (Lane Poole 1920b, p.130).

A utilitarian view was not the sum of early foresters' awareness of the significance of forests and the concept of conserving 'over-mature' trees strikes a chord with conservation. It is harder to find evidence of early agriculturalists' concern for conservation, but many landholders clearly hoped to farm their lands long-term and not to cause lasting damage to productivity. Today,

that heritage is expressed in a wide range of case studies seeking to conserve biodiversity in agricultural landscapes (Lindenmayer *et al.* 2011; Norton and Reid 2013).

Professionalism characterised forestry from the earliest days, with the emphasis on accredited qualifications and publishing bulletins (Lane Poole 1921; Williamson *et al.* 2005, Dargavel 2008). Agriculture was more ambivalent toward scientific advice. Development of new strains of wheat and improved fertilisers proved popular, but warnings of possible land degradation associated with clearing landscapes prone to dryland salinity were disregarded (Beresford *et al.* 2001). The early conservationists certainly counted scientists among their members, although degree courses in conservation biology only became available in Australian universities late in the 20th century. At times, all three groups were at odds with political expediency, whether it be about timber overcutting, dryland salinity or the need for nature conservation.

Lastly, all three groups have utilitarian components. While these are most obvious for forestry and agriculture, conservationists focus increasingly on opportunities to combine conservation with production (Lindenmayer *et al.* 2011; Norton and Reid 2013). This is because existing reserves are few, static, seldom representative, and too isolated or small to protect or sustain viable populations and natural ecological processes. Thus, biodiversity conservation must involve both reserves and sympathetic management of biodiversity in production landscapes (Lindenmayer and Franklin 2002). In this context, forest management in Western Australia now embraces multiple use, considering biodiversity conservation alongside traditional values such as timber production. Such a synthesis presents what Brennan (2004) called a 'wicked' public policy problem, because the issues are seldom defined clearly and legitimate, but opposing, value systems clash. Nevertheless, successes are claimed (Hobbs and Saunders 2000, Norton and Reid 2013).

The common concerns of forestry, agriculture, and conservation for stewardship, professionalism, and utility all involve long-term visions for landscape use, albeit for different purposes. Lane Poole (1920a, p.34), for example, looked forward to the day 'when the people develop a forest conscientiousness [sic] ... and they themselves will see to it that the forest policy is maintained and the forests are used for the benefit of the community as a whole, forever, and not for the benefit of the few sawmillers, timber hewers, and timber merchants of to-day [sic]'. These long-term visions have often been frustrated by short-term political expediency. Significantly, they also omit any discussion of the culture and heritage of the indigenous people of the south-west, the Noongar. The combined experiences of all three groups argue for the long-term view in planning land use in the south-west, while the absence of any acknowledgement of indigenous heritage indicates a significant gap in the thinking of the time.

Recent developments in forest conservation

The passing of the Forests Act 1918 heralded an expansion of State forest, silvicultural reconstruction, fire exclusion, and emphasis on timber production and water catchment protection until the mid-1960s. Despite the inevitable struggle to establish State forest in the face of pressure for agricultural clearing, the area of State forest expanded rapidly and, by 1929, approximated 60 % of its 2000 extent. After 1929, State forest reservation stalled in jarrah forest areas, with only another 100 000 ha added up to 1954 (most in 1938; Rundle 1996).

The post 1960s period was characterized by recognition of multiple-use values in management plans, replacement of fire exclusion with prescribed burning, intensive utilization of forest products, the introduction of large-scale extractive industries (e.g. bauxite mining, woodchipping, and replacement of jarrah forest by pine plantation in the Blackwood Plateau) and increasing concern for fauna conservation reserves (Rundle 1996; Calver and Wardell-Johnson 2004). Some areas of State forest were set aside from timber production as Management Priority Areas (MPAs) for flora, fauna or landscape (Wardell-Johnson and Calver 2005). However, conservation groups argued that security of purpose should not be equated with security of tenure, and urged altered vesting to reflect purpose. This was foreshadowed in General Working Plan 87 of 1982 (see Wardell-Johnson and Calver 2005). While the 1982 plan set in train the transfer of over 500 000 ha from forest reserves to conservation reserves, these areas had effectively not been available for timber production since the early 1970s. In 1994, the State Government adopted Ecologically Sustainable Forest Management from native State forest as policy (CALM 1994), and proposals to transfer forest reserves to conservation reserves continued despite administrative complexity.

The 2004 forest management plan (Conservation Commission, WA 2004) formally recognized that flora, fauna and landscape MPAs were not available for timber production. This plan also substantially increased other areas to be allocated as conservation reserves, particularly a large area in the Warren and southern part of the Jarrah Forest Bioregions to be formally named the Walpole Wilderness Area, an expansion of the previously gazetted Lane Poole National Park, and several areas of the Blackwood Plateau (Conservation Commission, WA 2004). There was recognition in the plan of a reduced area available for logging as a result of an expansion of the formal and informal reserve system, the creation of fauna habitat zones, changes to silviculture, and provision of risk factors, such as the impact on timber yields resulting from the forecast spread of the plant pathogens *Phytophthora* spp. (Conservation Commission, WA 2004). Furthermore, considerable emphasis on monitoring the implementation of the policy and re-viewing its adequacy

was provided in this plan. Systematic and informal monitoring were expanded, performance indicators for assessing the effectiveness of the plans implementation were introduced, formal adaptive management through experiment was prescribed, and compliance auditing with public reporting was expanded (e.g., Abbott and Williams 2011, McCaw *et al.* 2011 and included references). The plan also recognized the existence of mineral and petroleum operations on land to which the plan applies, but which are approved and conducted through government processes outside the control of the plan.

As Havel (1989, p. 379) noted: 'There are many angles from which the status of conservation of a region could be considered, but perhaps the most important question is "Is the provision made for the conservation of flora and fauna in the region adequate?"' Simplistic answers to this question are rarely lacking, in that those with a bias towards preservation will never accept that enough has been reserved ..., whereas those with a bias towards development will tend to view any reservation as an unnecessary locking up of valuable economic resources.'

To these considerations we add the realisation that conservation reserves alone will not protect biodiversity, but that resource extraction such as mining, forestry, and agriculture must be conducted with multiple use goals, including contributing to biodiversity conservation (e.g., Grigg *et al.* 1995; Hale and Lamb 1997; Lindenmayer and Franklin 2002).

In south-western Australia, the initial driving forces for conservation reserves were aesthetic, combined with lack of appeal for resource development (Rundle 1996), all factors involved in the original selection of the South Dandalup Reserve. More recently, concern shifted in the 1950s to recognising important vegetation complexes and endangered fauna (Rundle 1996) and the contemporary concerns for a comprehensive, adequate and representative reserve system (Havel 1989, Rundle 1996, Gove *et al.* 2008), as well as biodiversity-sensitive regulation of resource extraction (Koch and Hobbs 2007, McCaw *et al.* 2011, Lee *et al.* 2013a,b). This is set against a background of rising empowerment of 'citizen scientists' alongside professionals in arguing for conservation and reservation (Gaynor 2014) and a deepening understanding of the ecosystems concept (Mucina and Wardell-Johnson 2011; Hopper 2013). However, although power relationships and scientific knowledge may have shifted in relation to these disparate views and interests from the balance prevailing during the short life of the South Dandalup Reserve, the complex elements of attitudes toward the environment and natural resources remain the same. In that sense, the historical view is timeless in providing context to on-going significant debates about land use and conservation, in south-western Australia and elsewhere.

A significant blind spot in land use planning post 1826 has been the exclusion of indigenous culture and heritage. This has been more substantially addressed through recent Forest Management Planning (Conservation Commission 2004, 2013).

Nevertheless, the intrinsic productive capacity of landscapes, recognized from a deep-time perspective, has bearing on long-term sustainability and conservation, but is still not fully part of the consciousness of a climate-challenged environment. Much of the Jarrah Forest Bioregion occurs in an ancient landscape of inherently low productivity, a situation not readily apparent to early colonists. Early colonists and associated politicians were highly impressed by the biomass of the forested south-west region. The low intrinsic productivity of the jarrah forests was no doubt a factor in allowing forestry interests to be a major force in early land-use decisions, and became prominent as productive capacity declined following prolonged exploitation. The prolonged downward trend in jarrah yield commencing in the late 1960s (Calver and Wardell-Johnson 2004) preceded changes in purpose to the conservation estate, but foreshadowed the combined impacts of protracted exploitation and on-going warming, drying trends under climate change in the region (Wardell-Johnson *et al.* 2011).

The inherently low productivity of ancient landscapes (Mucina and Wardell-Johnson 2011; Sander and Wardell-Johnson 2011) may offer the best long-term hopes for conservation in the jarrah forest environment. Thus a focus on veneration and resilience of systems despite great change may provide increasing hope for a longer-term conservation ethic in the jarrah forest in the face of disruptive climate change. The 'development ... greatly assisted by nature' referred to by Nunn (1957, p.3) may have inadvertently described the intrinsic resilience of the jarrah forest landscape. No doubt Nunn was not expecting that this forest would produce ever-decreasing volumes of timber as time went on. However, in its entirety the jarrah forest is a landscape of great importance to the nation for fauna and flora conservation, and as a source of inspiration for resilience in the face of 170 years of exploitation and over 40 years of a drying, warming climate (Wardell-Johnson *et al.* 2015). For this much is owed to the early lively debates and engagement by committed professionals on the trajectory to today's scarred but persistent jarrah forest environment.

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